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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re application of	:	**Confirmation No. 6970**
Takahiro OSHITA et al.	:	Docket No. 01213/GEB667-US
Serial No.09/180,601	:	Group Art Unit 1764
Filed November 10, 1998	:	Examiner A. Doroshenk

FLUIDIZED-BED GASIFICATION METHOD AND APPARATUS

THE COMMISSIONER IS AUTH… TO CHARGE ANY DEFICIENCY … FEES FOR THIS PAPER TO DEP… ACCOUNT NO. 23-0975

APPELLANTS' SUPPLEMENTAL BRIEF
UNDER 37 CFR 1.192

Assistant Commissioner for Patents
Washington, DC 20231

Sir:

The following is the Appellant's Brief, submitted in triplicate and in accordance with the provisions of 37 CFR 1.192.

1. REAL PARTY IN INTEREST.

The real party in interest is Ebara Corporation of Tokyo, Japan, the assignee of the present invention.

2. RELATED APPEALS AND INTERFERENCES.

This appeal is a reinstatement of the appeal originally filed in this application on January 13, 2003. However, there are no known related appeals or interferences.

3. STATUS OF CLAIMS.

Original claims 1-10 were cancelled and replaced by claims 11-24 in the amendment of September 25, 2000. Subsequently, claims 11 and 21 were cancelled, claims 12, 16, 20, and 22-

24 were amended, and claims 25-28 were added in the amendment of August 31, 2001. Finally, claims 29 and 30 were added in the amendment of May 20, 2002. Thus, claims 12-20 and 22-30 are pending, and the rejection of these claims is appealed. A complete copy of the claims on appeal is provided in the Appendix.

4. STATUS OF AMENDMENTS.

No amendments subsequent to the Office Action of May 13, 2003 have been submitted.

5. SUMMARY OF THE INVENTION.

The present invention is directed to a two-stage combustion method and apparatus in which combustible gas is generated *at a controlled temperature* in a first-stage fluidized-bed furnace, and then delivered to a second-stage melt combustion furnace for complete combustion, thereby producing exhaust gas. As used in this application, the term "combustible gas" means gas produced by partial combustion of combustible waste materials (e.g., gasification) (see page 12, lines 22-28). The term "exhaust gas," on the other hand, means gas produced by complete combustion of combustible waste materials, which can be used to generate steam or drive a turbine, but which can not be used for combustion because it has already been completely burned (see page 3, lines 10-19). In contrast to the exhaust gas, the combustible gas has a high calorific value, and can be used as fuel or used for combustion in a second-stage melt combustion furnace, as in the present invention (see page 13, lines 20-27, and page 38, line 27 through page 39, line 8). Fig. 1 shows a gasifying apparatus 1 for conducting a gasification method of the present invention, and the method and apparatus will be described below with reference to this figure.

Combustible material (i.e., combustible waste material) F enters a fluidized-bed furnace 51 through a supply port 66 (see page 18, lines 7-11). A fluidized medium circulating within the fluidized-bed furnace 51 is heated and gasifies the combustible waste material (see page 13, lines 13-15). In this regard, the swirling circulation of the fluidized medium forms a gasifying zone G within the bed for gasification of the combustible waste materials, and an oxidizing zone S within the bed for oxidizing char and tar 114, which are difficult to oxidize. Specifically, in the oxidizing

zone S, the char and tar are partially combusted by contacting a fluidizing gas including oxygen, and are partially oxidized (see page 13, lines 4-10 and 20-25). Because gasification of not only volatile material but also char is efficiently accomplished, the gasification efficiency is increased, and the fluidized-bed furnace produces high-quality combustible gas (see page 13, line 18 through page 14, line 6).

The generated combustible gas and non-combusted particles (i.e., char) 29 flow upward within the fluidized-bed furnace 51 toward the gas outlet 68. The combustible gas and non-combusted particles (char) 29 are then delivered through the gas outlet 68 to the melt combustion furnace 41 for complete combustion therein (see page 14, lines 16-28). Thus, the initial gasification of waste materials to produce combustible gas and char, coupled with the subsequent complete combustion of the combustible gas and char in the melt combustion furnace, enables the complete decomposition of dioxin and other toxic materials. In addition, the resulting slag material can be recovered and used as, for example, building materials, so that the amount of material to be disposed of in a landfill is significantly reduced.

It is desirable to maintain a predetermined temperature in the fluidized bed of the fluidized-bed furnace in order to avoid undesirable clinker, and because the combustion of the combustible gas within the melt combustion furnace is highly sensitive to the conditions of the combustible gas and, particularly, the temperature of the combustible gas (see page 3, line 22 through page 4, line 15 of the specification). Unfortunately, however, treating high-calorie waste materials in conventional fluidized-bed furnaces can be problematic. Specifically, the exothermic reaction of high-calorie waste material and fluidized air during the gasification process will tend to raise temperatures in conventional fluidized-bed furnaces above the desired predetermined levels. A simple reduction in the amount of fluidized air within the fluidized-bed furnace will help maintain the desired predetermined temperatures when treating high-calorie waste materials. However, such a reduction in the amount of fluidized air would result in insufficient fluidization and, therefore, is not a sufficient way to address the problems encountered when treating high-calorie waste materials.

Therefore, there are several possible options for addressing the problems involving potentially high temperatures caused by high-calorie waste materials discussed above. A first option is to reduce the concentration of oxygen in the fluidized air by adding steam or combustion exhaust gas, thereby increasing the overall amount of fluidizing gas within the fluidized-bed furnace. Lowering the concentration of oxygen supplied to the fluidized-bed furnace in this manner will reduce the amount of calories being consumed in the fluidized-bed furnace, thereby enabling the predetermined temperature of the fluidized bed to be maintained. However, the non-consumed calories are then transmitted to the melt combustion furnace for combustion therein. A large amount of air is required for combustion of the non-consumed calories at a predetermined temperature within the melt combustion furnace. Therefore, the amount of combustion exhaust gas will increase and the amount of heat recovery in a subsequent stage will be reduced. Furthermore, the use of steam will reduce the amount of energy recovery, and the use of combustion exhaust gas makes the temperature of the fluidized bed unstable.

A second option, employed in the present invention, is to maintain a desirable concentration of oxygen without changing the amount of fluidized gas, while maintaining a predetermined temperature in the fluidized bed of the fluidized-bed furnace by removing excess heat from a heat recovery region of the fluidized bed. Specifically, the fluidized-bed furnace 1 of the present invention also has a heat recovery region 59 in which heat is recovered from the circulating fluidized medium so as to maintain the temperature in the fluidized bed at a predetermined temperature without having to undesirably reduce the amount of fluidized air or the concentration of oxygen (see page 16, line 18 through page 17, line 14). Therefore, even if the combustible waste materials include plastics or similar materials with a high calorific value, the temperature of the fluidized-bed furnace can be maintained at a desired level, while the air ratio and temperature of the melt combustion furnace can also be maintained at desired levels. Thus, even high-calorie waste materials can be processed under the same conditions as general municipal wastes, the amount of generated exhaust gas can be minimized, and the amount of heat recovery can be maximized. The minimized amount of exhaust gas can, in turn, reduce the cost of equipment for processing gas.

6. ISSUES.

The issue is whether claims 12-20 and 22-30 are unpatentable under 35 USC 103(a) as being obvious in view of the combination of Hirayama et. al., U.S. Patent No. 5,620,488 (the Hirayama reference) and Ohshita et. al., U.S. Patent No. 5,156,099 (the Ohshita reference).

7. GROUPING OF CLAIMS.

Claims 12-20, 25 and 26 stand or fall together, and do not stand or fall with claims 22-24 and 27-30.

Claims 22-24 and 27-30 stand or fall together, and do not stand or fall with claims 12-20, 25 and 26.

8. ARGUMENT.

Procedural History

In a non-final Office Action dated November 19, 2001, the Examiner asserted that the Ohshita reference (the primary reference applied in that Office Action) discloses a fluidized-bed furnace apparatus including a combustion region for generating a combustible gas and particles, a heat recovery region, and a fluidized medium that is circulated within the fluidized-bed furnace. In this regard, the Examiner asserted that column 7, lines 58-67 of the Ohshita reference teaches the combustion region that generates combustible gas and particles. The Hirayama reference was applied as a secondary reference.

In the remarks in support of the amended claims filed on May 20, 2002, the Applicants explained that the present invention is directed to a two-stage combustion method and apparatus, in which combustible gas is generated in a first-stage fluidized-bed furnace. It was further explained that, in contrast to the present invention, the Ohshita reference discloses a fluidized-bed boiler in which coal or waste materials are completely combusted in a fluidized bed so as to produce exhaust gas.

Nonetheless, in the final Office Action of August 14, 2002, the Examiner maintained the rejections, while acknowledging the Applicants' argument that the Ohshita reference does not

disclose a furnace that produces a "combustible gas", but rather an "exhaust gas." In this regard, the Examiner asserted that simply because the Ohshita reference teaches that the fuel "can" be completely burned does not preclude that the fuel *not* be completely burned. In addition, the Examiner also asserted that the Ohshita reference teaches that the gas exiting the fluidized bed furnace is a "combustible gas", and refers to column 3, lines 27-30.

In view of the final Office Action, an appeal was filed on January 13, 2003, and the required appeal brief was filed on March 7, 2003. In the appeal brief, the Applicants traversed the Examiner's rejections with arguments similar to those originally presented in the response to the Examiner's non-final Office Action of November 19, 2001, and similar to those presented in the Request for Reconsideration filed on December 16, 2002.

In view of the Applicants arguments set forth in the appeal brief, the Examiner has now reopened prosecution and issued a new, non-final Office Action on May 13, 2003. Although the Examiner has applied the same two references applied in the final Office Action of August 14, 2002, the Examiner has now applied them in a new manner: the Hirayama reference is now the primary reference, and the Ohshita reference is now a secondary reference. Specifically, the Examiner asserts that the Hirayama reference discloses a *heat recovery region S*, but does not disclose a heat recovery surface in the heat recovery region. Nonetheless, the Examiner asserts that the Ohshita reference discloses a similar fluidized-bed apparatus including a heat recovery region 4 with a heat recovery surface 5. However, as explained in detail below, it is submitted that the Examiner's understanding of the Hirayama reference is incorrect, and that the references can not be combined as suggested by the Examiner.

Claims 12-20, 25, and 26 Are Patentable Over the Prior Art

Claims 12-20, 25, and 26, including independent claims 20 and 25, are directed to a method of treating combustibles. In particular, independent claims 20 and 25 recite that a fluidized medium is circulated within a fluidized-bed furnace so as to be heated. Combustible materials are gasified so as to generate combustible gas and non-combusted particles (char). *Heat is recovered from the fluidized medium*, and the combustible gas and non-combusted particles

(char) are subsequently delivered to a melt combustion furnace and completely combusted in the melt combustion furnace.

The Hiryama reference discloses a method of fluidized-bed gasification and melt combustion in which a fluidized medium is circulated within a fluidized-bed furnace to generate combustible gas. However, contrary to the Examiner's assertion on page 2 of the Office Action of May 13, 2003, the Hirayama reference does not disclose or even suggest a *heat recovery region*. In contrast, region S shown in Figures 1 and 3 of the Hirayama reference indicates a combustible matter oxidizing zone, rather than a heat recovery region (see column 10, lines 30-34) as suggested by the Examiner. Thus, the Hirayama reference does not disclose or suggest recovering heat from a fluidized medium heated by gasification of combustibles.

The invention disclosed in the Hirayama reference encounters problems when treating high-calorie waste materials due to the potential increased temperatures in the fluidized-bed furnace. However, if the amount of fluidized air is reduced in an attempt to maintain a predetermined temperature in the fluidized bed, then fluidization will be insufficent as discussed above in the Summary of the Invention. As a result, continuous operation is difficult.

The Ohshita reference discloses a fluidized-bed *boiler*, including a thermal energy recovery chamber 4 with heat transfer tubes 5 (see Figure 1). However, as explained in the Appeal Brief filed March 7, 2003, *complete combustion* is performed in the fluidized-bed boiler of the Ohshita reference, and the heat transfer tubes 5 are provided in order to recover thermal energy during the complete combustion process. Consequently, the Ohshita reference also does not disclose or suggest recovering heat from a fluidized medium heated by *gasification* of combustibles.

As explained above, neither the Hirayama reference nor the Ohshita reference discloses or suggest recovering heat from a fluidized medium in a fluidized-bed furnace in which combustibles are *gasified*. Moreover, one of ordinary skill in the art would not be motivated to modify the Hirayama reference to include the thermal energy recovery chamber 4 or heat transfer tubes 5 of the Ohshita reference. In particular, when heat recovery is conducted during gasification (as in the present invention), the generated combustible gas has a *reduced* calorie content because the

amount of nitrogen mixed with the generated gas is increased. However, an object of the Hirayama reference is to generate combustible gas having a *high* calorie content (see column 3, lines 25-30 of the Hirayama reference) by efficient gasification of combustibles. Thus, the thermal energy recovery process of the Ohshita reference would be inconsistent with the object of the Hirayama reference as discussed above.

In view of the above, one of ordinary skill in the art would not be motivated by the Ohshita reference so as to modify the Hirayama reference in order to obtain the invention recited in independent claims 20 and 25. Accordingly, it is respectfully submitted that independent claims 20 and 25, and the claims that depend therefrom, are clearly patentable over the prior art of record.

<u>Claims 22-24 and 27-30 Are Patentable Over the Prior Art</u>

Claims 22-24 and 27-30, including independent claims 24, 27, and 29, are directed to an apparatus for treating combustibles. In particular, independent claims 24, 27, and 29 recite that the apparatus comprises a fluidized-bed furnace having a region for gasifying combustibles so as to generate combustible gas and non-combusted particles (char), having *a heat recovery region,* and having a fluidized medium operable to circulate within the fluidized-bed furnace. A heat recovery surface in the fluidized-bed furnace recovers heat from the fluidized medium, and a melt combustion furnace receives and combusts the combustible gas and the non-combusted particles (char) generated in the fluidized-bed furnace.

As explained above, the Hirayama reference <u>does not</u> disclose or suggest a fluidized-bed furnace for generating combustible gas and non-combusted particles, in which the fluidized-bed furnace includes a heat recovery region. Although the Ohshita reference discloses a fluidized-bed *boiler for completely combusting combustibles,* and includes a thermal energy recovery chamber 4 with heat transfer tubes 5, the Ohshita reference also <u>does not</u> disclose or suggest a fluidized-bed furnace *for gasifying combustibles,* in which the fluidized-bed furnace includes a heat recovery region.

In addition, one of ordinary skill in the art would not be motivated to combine the Ohshita reference and the Hirayama reference so as to obtain the invention recited in independent claims 24, 27, and 29 because the addition of the thermal energy recovery chamber of the Ohshita reference (which would tend to *reduce* the calorie content of the combustible gas) would be inconsistent with the object of the Hirayama reference (which is to generate a combustible gas with a *high* calorie content).

In view of the above, one of ordinary skill in the art would not be motivated by the Ohshita reference so as to modify the Hirayama reference in order to obtain the invention recited in independent claims 24, 27, and 29. Accordingly, it is respectfully submitted that independent claims 24, 27, and 29, and the claims that depend therefrom, are clearly patentable over the prior art of record.

Conclusion

In view of the above, it is submitted that claims 12-20 and 22-30 are patentable over the prior art of record, including the combination of the Hirayama reference and the Ohshita reference. Accordingly, the Board is respectfully requested to reverse the rejections set forth in the Office Action of May 13, 2002.

This brief is submitted in triplicate.

Respectfully submitted,

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9. **APPENDIX:** Claims Pending on Appeal - Serial No. 09/180,601.

12. A method as claimed in claim 20, wherein said combustion region and said heat recovery region are separated by a partition wall and are connected above and below said partition wall, said combustion region includes first and second areas adjacent to each other, and further comprising:

supplying a first fluidizing gas as an upward flow into said first area, supplying a second fluidizing gas as an upward flow into said second area, and supplying heat recovery region fluidizing gas to said heat recovery region;

controlling a mass flow of said first fluidizing gas to be smaller than a mass flow of said second fluidizing gas to create in said first area a moving bed where said fluidized medium descends and is dispersed and to create in said second area a fluidized bed where said fluidized medium is fluidized, whereby said combustibles are gasified into a combustible gas in said combustion region while circulating therein with said fluidized medium; and

flowing said fluidized medium from said combustion region over said partition wall into said heat recovery region, and returning said fluidized medium in said heat recovery region to said combustion region; and

said controlling comprises adjusting said supplying said heat recovery region fluidizing gas to said heat recovery region.

13. A method as claimed in claim 12, further comprising regulating a temperature in said fluidized-bed furnace.

14. A method as claimed in claim 13, wherein said regulating comprises, as a primary temperature control, controlling a temperature in said combustion region by adjusting said supplying said first fluidizing gas to said first area and said supplying said second fluidizing gas to said second area, and, as an auxiliary temperature control, controlling a temperature in said heat

recovery region by said adjusting said supplying said heat recovery region fluidizing gas to said heat recovery region.

15. A method as claimed in claim 13, wherein said regulating comprises, as an auxiliary temperature control, controlling a temperature in said combustion region by adjusting said supplying said first fluidizing gas to said first area and said supplying said second fluidizing gas to said second area, and, as a primary temperature control, controlling a temperature in said heat recovery region by said adjusting said supplying said heat recovery region fluidizing gas to said heat recovery region.

16. A method as claimed in claim 20, wherein said fluidized-bed furnace has a substantially circular cross-sectional shape, said combustion region comprises a circular central region, said heat recovery region comprises an outer peripheral region, said combustion region and said heat recovery region are separated by a partition wall and are connected above and below said partition wall, said combustion region includes central and peripheral areas adjacent to each other, and further comprising:

supplying a central fluidizing gas as an upward flow into said central area, supplying a peripheral fluidizing gas as an upward flow into said peripheral area, and supplying heat recovery region fluidizing gas to said heat recovery region;

controlling a mass flow of one of said central fluidizing gas and said peripheral fluidizing gas to be smaller than a mass flow of the other of said peripheral fluidizing gas and said central fluidizing gas, to create in one of said central area and said peripheral area a moving bed where said fluidized medium descends and is dispersed and to create in the other of said peripheral area and said central area a fluidized bed where said fluidized medium is fluidized, whereby said combustibles are gasified into a combustible gas in said combustion region while circulating therein with said fluidized medium; and

flowing said fluidized medium from said combustion region over said partition wall into said heat recovery region, and returning said fluidized medium in said heat recovery region to said combustion region; and

said controlling comprises adjusting said supplying said heat recovery region fluidizing gas to said heat recovery region.

17. A method as claimed in claim 16, further comprising regulating a temperature in said fluidized-bed furnace.

18. A method as claimed in claim 17, wherein said regulating comprises, as a primary temperature control, controlling a temperature in said combustion region by adjusting said supplying said central fluidizing gas to said central area and said supplying said peripheral fluidizing gas to said peripheral area, and, as an auxiliary temperature control, controlling a temperature in said heat recovery region by said adjusting said supplying said heat recovery region fluidizing gas to said heat recovery region.

19. A method as claimed in claim 17, wherein said regulating comprises, as an auxiliary temperature control, controlling a temperature in said combustion region by adjusting said supplying said central fluidizing gas to said central area and said supplying said peripheral fluidizing gas to said peripheral area, and, as a primary temperature control, controlling a temperature in said heat recovery region by said adjusting said supplying said heat recovery region fluidizing gas to said heat recovery region.

20. A method of treating combustibles, said method comprising:

circulating a fluidized medium between a combustion region and a heat recovery region within a bed of a fluidized-bed furnace such that said fluidized medium is heated in said combustion region;

gasifying combustibles in said combustion region of said fluidized-bed furnace, thus generating combustible gas and non-combusted particles;

recovering heat from said fluidized medium in said heat recovery region of said fluidized-bed furnace after said fluidized medium has been heated in said combustion region, so as to thereby control a temperature of said bed; and

delivering said combustible gas and non-combusted particles to a melt combustion furnace and therein combusting said combustible gas and melting non-combustible ash of said non-combusted particles.

22. An apparatus as claimed in claim 24, wherein said combustion region and said heat recovery region are separated by a partition wall, said combustion region includes first and second areas adjacent to each other, and further comprising:

an air diffusion device to supply a first fluidizing gas as an upward flow into said first area, to supply a second fluidizing gas as an upward flow into said second area, and to supply heat recovery region fluidizing gas to said heat recovery region, said air diffusion device being structured such that a mass flow of said first fluidizing gas is smaller than a mass flow of said second fluidizing gas to create in said first area a moving bed where said fluidized medium descends and is dispersed and to create in said second area a fluidized bed where said fluidized medium is fluidized, whereby said combustibles are gasified into a combustible gas in said combustion region while circulating therein with said fluidized medium; and wherein

said combustion region and said heat recovery region are connected above and below said partition wall, to allow said fluidized medium from said combustion region to flow over said partition wall into said heat recovery region;

said heat recovery surface comprises a member in said heat recovery region for a medium to pass therethrough; and

said air diffusion device includes a heat recovery region air diffuser at a bottom of said heat recovery region, said heat recovery air diffuser being structured to adjust the supply of said

heat recovery region fluidizing gas to said heat recovery region to cause said fluidized medium in said heat recovery region to descend therein as a moving bed and to circulate therefrom below said partition wall back to said combustion region.

23. An apparatus as claimed in claim 24, wherein said fluidized-bed furnace has a substantially circular cross-sectional shape, said combustion region comprises a circular central region, said heat recovery region comprises a peripheral region, said combustion region and said heat recovery region are separated by a partition wall, said combustion region includes central and peripheral areas adjacent to each other, and further comprising:

an air diffusion device to supply a central fluidizing gas as an upward flow into said central area, to supply a peripheral fluidizing gas as an upward flow into said peripheral area, and to supply heat recovery region fluidizing gas to said heat recovery region, said air diffusion device being structured such that a mass flow of one of said central fluidizing gas and said peripheral fluidizing gas is smaller than a mass flow of the other of said peripheral fluidizing gas and said central fluidizing gas to create in one of said central area and said peripheral area a moving bed where said fluidized medium descends and is dispersed and to create in the other of said peripheral area and said central area a fluidized bed where said fluidized medium is fluidized, whereby said combustibles are gasified into a combustible gas in said combustion region while circulating therein with said fluidized medium; and wherein

said combustion region and said heat recovery region are connected above and below said partition wall, to allow said fluidized medium from said combustion region to flow over said partition wall into said heat recovery region;

said heat recovery surface comprises a member in said heat recovery region for a medium to pass therethrough; and

said air diffusion device includes a heat recovery region air diffuser at a bottom of said heat recovery region, said heat recovery air diffuser being structured to adjust the supply of said heat recovery region fluidizing gas to said heat recovery region to cause said fluidized medium in

said heat recovery region to descend therein as a moving bed and to circulate therefrom below said partition wall back to said combustion region.

24. An apparatus for treating combustibles, said apparatus comprising:

a fluidized-bed furnace including a bed having a combustion region for gasifying combustibles so as to generate combustible gas and non-combusted particles, and having a heat recovery region, said fluidized-bed furnace further including a fluidized medium operable to circulate between said combustion region, whereat said fluidized medium is heated, and said heat recovery region;

a heat recovery surface in said heat recovery region for recovering heat from said fluidized medium after said fluidized medium has been heated in said in said combustion region, so as to thereby control a temperature of said bed; and

a melt combustion furnace for receiving the combustible gas and the non-combusted particles and for combusting the combustible gas and melting non-combustible ash of the non-combusted particles.

25. A method of treating combustibles, said method comprising:

circulating a fluidized medium between a combustion region and a heat recovery region within a bed of a fluidized-bed furnace such that said fluidized medium is heated in said combustion region;

gasifying combustibles in said combustion region, thus generating combustible gas and non-combusted particles;

recovering heat from said fluidized medium after said fluidized medium has been heated in said combustion region; and

delivering said combustible gas and non-combusted particles to a melt combustion furnace and therein combusting said combustible gas and melting non-combustible ash of said non-combusted particles.

26. A method as claimed in claim 25, further comprising maintaining said bed of said fluidized-bed furnace at a temperature of 450°C to 800°C, and wherein said melting of said non-combustible ash of said non-combustible particles is conducted at a temperature of at least 1300°C.

27. An apparatus for treating combustibles, said apparatus comprising:

a fluidized-bed furnace including a bed having a combustion region for gasifying combustibles so as to generate combustible gas and non-combusted particles, and having a heat recovery region, said fluidized-bed furnace further including a fluidized medium operable to circulate between said combustion region and said heat recovery region;

a heat recovery surface in said heat recovery region for recovering heat from said fluidized medium after said fluidized medium has been heated in said combustion region; and

a melt combustion furnace for receiving the combustible gas and the non-combusted particles and for combusting the combustible gas and melting non-combustible ash of the non-combusted particles.

28. An apparatus as claimed in claim 27, wherein said heat recovery surface is operable to recover heat from said fluidized medium so as to maintain said bed of said fluidized-bed furnace at a temperature of 450°C to 800°C, and wherein said melt combustion furnace is operable to melt said non-combustible ash of said non-combustible particles at a temperature of at least 1300°C.--

29. An apparatus for treating combustibles, said apparatus comprising:

a fluidized-bed furnace having a gasification region for gasifying combustibles so as to generate combustible gas and non-combusted particles, and having a heat recovery region, said fluidized-bed furnace further including a fluidized medium operable to circulate between said gasification region and said heat recovery region;

a heat recovery surface in said heat recovery region for recovering heat from said fluidized medium; and

a melt combustion furnace for receiving the combustible gas and the non-combusted particles and for combusting the combustible gas and melting non-combustible ash of the non-combusted particles.

30. An apparatus as claimed in claim 29, wherein said heat recovery surface is operable to recover heat from said fluidized medium so as to maintain said fluidized-bed furnace at a temperature of 450°C to 800°C, and wherein said melt combustion furnace is operable to melt said non-combustible ash of said non-combustible particles at a temperature of at least 1300°C.